

This Page Is Inserted by IFW Operations  
and is not a part of the Official Record

## **BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning documents *will not* correct images,  
please do not report the images to the  
Image Problem Mailbox.**

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION  
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :  E04C 2/24, 2/36, B32B 15/12	A1	(11) International Publication Number: WO 91/10023  (43) International Publication Date: 11 July 1991 (11.07.91)
(21) International Application Number: PCT/GB90/01982  (22) International Filing Date: 19 December 1990 (19.12.90)		(74) Agent: GALLAFENT & CO.; 8 Staple Inn, London WC1V 7QH (GB).
(30) Priority data: 8928988.8 22 December 1989 (22.12.89) GB		(81) Designated States: AT (European patent), BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), LU (European patent), NL (European patent), SE (European patent), US.
(71) Applicant ( <i>for all designated States except US</i> ): DUFAY-LITE DEVELOPMENTS LIMITED [GB/GB]; Cromwell Road, St Neots, Cambridgeshire PE19 1QW (GB).  (72) Inventors; and (75) Inventors/Applicants ( <i>for US only</i> ) : THWAITES, Peter, John [GB/GB]; 3 Meadow View, Eltisley, Cambridgeshire PE19 4TP (GB). COWLING, Derek, Stanley [GB/GB]; 1 Conley Close, Ramsey, Cambridgeshire PE17 1EL (GB).		Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

(54) Title: LIGHTWEIGHT COMPOSITE PANELS

(57) Abstract

Composite panels consist of a core and a facing adhered each side of the core. The core may be of cellular material, for example expanded honeycomb, plastics foam or corrugated cardboard. The facings are of paper or card to each side of which a thin foil, e.g. an aluminium foil, is adhered. The face of the facing adhered to the core carries a primer layer to improve adhesion, for example a nitrocellulose lacquer primer. The other face may bear a flame retardant coating.

***FOR THE PURPOSES OF INFORMATION ONLY***

**Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.**

AT	Austria	ES	Spain	MG	Madagascar
AU	Australia	FI	Finland	ML	Mali
BB	Barbados	FR	France	MN	Mongolia
BE	Belgium	GA	Gabon	MR	Mauritania
BP	Burkina Faso	GB	United Kingdom	MW	Malawi
BG	Bulgaria	GN	Guinea	NL	Netherlands
BJ	Benin	GR	Greece	NO	Norway
BR	Brazil	HU	Hungary	PL	Poland
CA	Canada	IT	Italy	RO	Romania
CF	Central African Republic	JP	Japan	SD	Sudan
CG	Congo	KP	Democratic People's Republic of Korea	SE	Sweden
CH	Switzerland	KR	Republic of Korea	SN	Senegal
CI	Côte d'Ivoire	LJ	Liechtenstein	SU	Soviet Union
CM	Cameroon	LK	Sri Lanka	TD	Chad
CS	Czechoslovakia	LU	Luxembourg	TG	Togo
DE	Germany	MC	Monaco	US	United States of America
DK	Denmark				

- 1 -

### LIGHTWEIGHT COMPOSITE PANELS

This invention relates to lightweight composite panels.

Lightweight composite panels find application in numerous  
5 fields, particularly for forming screens, display boards  
and as infill panels in larger structures.

The panels generally consist of two surface skins, which  
may be the same or different, and which have between them  
10 a low bulk density filling. This may be, for example, a  
foam or a cellular structure, and one particular form of  
cellular structure, viz. a honeycomb structure has found  
widespread application. Composite panels with a honeycomb  
central structure are highly resistant to bending, thus  
15 giving rigidity to panels made in that way. An alternative  
cellular structure of value is a foam plastics material,  
for example a rigid polystyrene, polyurethane or other  
rigid polymer foam.

20 One of the major problems encountered in relation to such  
lightweight composite panels is imparting to them adequate  
fire retardancy and surface spread of flame resistance.  
The lightweight foam or cellular core may be inflammable,  
and the outer skins must act to protect the core. Another  
25 problem is the tendency of such panels to be sensitive to  
ambient conditions, particularly changes in humidity,

- 2 -

which can lead to difficulties such as warping or bending in practice. Flat surfaces are needed for aesthetic acceptance and for ease of subsequent processing, for example covering or printing.

5

European Patent Specification 0068873 discloses further details relating to the manufacture of composite panels of this type and proposes a way of overcoming the tendency to moisture or humidity sensitivity by using for the outer 10 facing layers of the panels paperboard having on each side a water impervious layer consisting of an adherent polymer coating which has been directly applied to the paperboard in a water- and solvent-free manner.

15

While undoubtedly effective to reduce or eliminate problems due to humidity changes, the manufacture of composite panels in accordance with the invention described in European Patent Specification 0068873 is difficult, not least because of the inert nature of the 20 surface of the water impervious layer. The specification suggests the use of corona discharge treatment to overcome these problems, but that treatment adds to the expense, and the effects of such treatment fade with time, so it is necessary to carry out subsequent processing steps rapidly 25 following the corona discharge treatment. This is disadvantageous from a manufacturing point of view.

30

We have now found a way of making improved composite panels of the type noted above which can be carried out simply and economically and which avoids the humidity 35 sensitivity problems noted above and at the same time increases the fire resistance of the panels.

35

According to the present invention, there is provided a composite panel consisting of a cellular core material having adhered each side thereof a facing material,

- 3 -

wherein the facing material consists of paperboard or cardboard to each side of which has been laminated a layer of metal foil and wherein the layer of metal foil adhered to the core is provided with a primer coat.

5

We have found that working in this way it is not necessary to use the solvent- and water-free applied polymer coatings suggested in the European specification referred to above. Rather, it is possible to use as the facing 10 material paperboard or cardboard to which metal foil, usually aluminium foil, has been laminated on both sides using standard water- or solvent-based laminating adhesives. In particular, standard latex or emulsion-type adhesives may be used at extremely low application rates, 15 for example as low as 2 gsm.

The core for lightweight panels in accordance with the present invention may be a core of honeycomb material or may be a rigid polymeric foam material. If honeycomb is 20 used, this may be an expandable card or paper honeycomb having hexagonal cells or it may be, e.g. a cellular card fill consisting of alternate straight and corrugated strips of card or paper. In both these types of core, the cells run perpendicular to the plane of the panel. To 25 assist stability, especially in the case of expandable honeycomb fill, the core may itself be faced with paper or light card, e.g. kraft paper or chipboard of basis weight 120-150 gsm. Such a paper facing can be advantageous in certain circumstances, for example, allowing a greater 30 range of cell sizes to be used whilst still supporting the faces adequately and secondly by facilitating the cutting of the core sections to precise size to fit within the cavity of the panel frame, thereby eliminating the risk of small voids occurring which can cause the depressions or 35 blemishes on the finished panel surface.

- 4 -

Alternatively, the core may be made up of alternate layers of paper or card and of corrugated paper or card. The paper or card layers may be of basis weight 120 to 300 gsm and the corrugated paper or card of basis weight 100 to  
5 125 gsm.

In all cases, the paper, card or foam material of the core may be treated with or include additives tending to reduce its combustibility. If the central core of the panels is,  
10 for example, a foam polystyrene or foam polyurethane, preferably (and essentially for certain applications) fire retardant (self-extinguishing) grades of such foam materials are used. One or both outer faces of the panels may also be coated with a fire retardant coating of known  
15 type further to reduce the combustibility of the panels.

The adhesion of the core material to the facing material is promoted by the use, on the side of the facing material adjacent to the core, of a primer material. A variety of  
20 materials is usable as primer, the criteria for selection being that the primer must adhere well to the surface of the metal foil on the one hand and be well receptive to adhesives with which the core material is to be adhesed on the other. Particularly preferred primers are  
25 nitrocellulose based lacquers. These are available in commerce in the printing industry.

The core material may be bonded to the primed face of the facing material using conventional composite panel  
30 adhesives, for example those based on urea formaldehyde resins or polyvinyl acetates.

The following examples will serve to illustrate the invention:

- 5 -

Example 1

As base material for the facing layers, a commercially available white lined chipboard, 800 microns thick and 5 having a basis weight of 566 grams per square metre was taken. This was laminated on both sides with standard 9 micron aluminium foil using a casein latex adhesive. The adhesive was applied at an application rate of 2 grams per square metre when dried down.

10 Subsequent to laminating, one side of the aluminium foil lined chipboard sheets was coated with a gravure print grade of nitrocellulose lacquer at a coating weight (dried down) of 1.5 grams per square metre. The other side was 15 coated with a white flame retardant coating at a rate giving a dried down coating weight of 1.5 grams per square metre.

Sheets of this facing material were then cut and adhered 20 using a conventional ureaformaldehyde adhesive to expanded card honeycomb to form composite panels. The thickness of the expanded honeycomb layer varied between 10 and 30 mm depending upon the particular honeycomb used.

25 Panels so manufactured were subjected to evaluation to determine their dimensional stability under conditions of altering relative humidity and were also subjected to surface spread of flame tests in accordance with BS 476, Part 7, 1987 to determine their suitability for use as 30 display panels for exhibition purposes. Satisfactory results were achieved on both counts. In particular, the maximum travel of flame damage from the point of flame impingement never exceeded 50 mm, well below the maximum permitted travel of 165 mm for certification to Class I, 35 BS 476, Part 7 1987.

- 6 -

Example 2

Sheets of facing material prepared as in Example 1 were cut and adhered using a conventional urea formaldehyde adhesive to sheets of rigid expanded polystyrene (self-extinguishing grade), 13 mm thick, to form composite panels.

Panels so manufactured were subjected to evaluation to determine their dimensional stability under conditions of altering relative humidity and were also subjected to surface spread of flame tests in accordance with BS 476, Part 7 1987 to determine their suitability for use as display panels for exhibition purposes. Satisfactory results were achieved on both counts. As in the case of the panels of Example 1, the maximum travel of flame damage from the point of flame impingement when the BS 476 test was carried out never exceeded 50 mm.

20 Example 3

Sheets of facing material prepared as in Example 1 were cut and adhered using a conventional urea formaldehyde adhesive to sheets of multilayer corrugated cardboard to form composite panels.

The multilayer corrugated cardboard consisted of a centre board (115 or 117 gsm chip liner) with a B or C flute corrugated semichemical board (110 or 112 gsm) adhered either side, with a kraft exterior skin (125, 150, 200 or 300 gsm) adhered to each of the corrugated boards. The precise combination of basis weights could be chosen to provide cores of overall thickness 5.5 to 8 mm, the choice depending on the final panel thickness, weight and strength desired.

- 7 -

Panels so manufactured were subjected to evaluation to determine their dimensional stability under conditions of altering relative humidity and were also subjected to surface spread of flame tests in accordance with BS 476,  
5 Part 7 1987 to determine their suitability for use as display panels for exhibition purposes. Satisfactory results were achieved on both counts.

Example 4

10 Expanded hexagonal paper honeycomb (cell size 13-15 mm, paper basis weight 130 gsm) of thickness (cell length) 9 mm was faced each side with a facing of 130 gsm chipboard, using a standard polyvinyl acetate adhesive. To each side  
15 of this core was adhered, using a standard ureaformaldehyde based adhesive, the printed side of sheets of facing material as in Example 1.

Panels having similar satisfactory properties with respect  
20 to insensitivity to changes in humidity and fire resistance were obtained.

- 8 -

CLAIMS

1. A composite panel consisting of a cellular core material having adhered each side thereof a facing material, characterised in that the facing material consists of paperboard or cardboard to each side of which has been laminated a layer of metal foil and wherein the layer of metal foil adhered to the core is provided with a primer coat.
- 10 2. A composite panel according to Claim 1, wherein the facing material is paperboard or cardboard to which aluminium foil has been laminated on both sides using a standard water- or solvent-based laminating adhesive at an application rate of 2 to 5 gsm.
3. A composite panel according to Claim 1 or 2, wherein the core is of honeycomb material, a rigid polymeric foam material, or a corrugated card fill.
- 20 4. A composite panel according to Claim 3, wherein the core is of an expandable card or paper honeycomb having hexagonal cells or a cellular card fill consisting of alternate straight and corrugated strips of card or paper.
- 25 5. A composite panel according to Claim 4, wherein each side of the core is faced with paper or light card.
- 30 6. A composite panel according to Claim 3, wherein the core is of alternating layers of paper or card and of corrugated paper or card.
- 35 7. A composite panel according to any one of Claims 1 to 6, wherein the material of the core is treated with or includes additives tending to reduce its combustibility.

- 9 -

8. A composite panel according to any one of Claims 1 to 7, wherein one or both surfaces of the facing material remote from the core carries a flame retardant coating.
- 5 9. A composite panel according to any one of Claims 1 to 8, wherein the primer coat is a nitrocellulose based lacquer.
- 10 10. A composite panel according to any one of Claims 1 to 9, wherein the core material is bonded to the face of the facing material provided with a primer coat by an adhesive based on a ureaformaldehyde resin or a polyvinyl acetate.

# INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 90/01982

## I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) \*

According to International Patent Classification (IPC) or to both National Classification and IPC

**IPC:** E 04 C 2/24, E 04 C 2/36, B 32 B 15/12

## II. FIELDS SEARCHED

Minimum Documentation Searched †

Classification System	Classification Symbols
IPC <sup>5</sup>	E 04 C, B 32 B

Documentation Searched other than Minimum Documentation  
to the Extent that such Documents are Included in the Fields Searched §

## III. DOCUMENTS CONSIDERED TO BE RELEVANT\*

Category *	Citation of Document, ** with indication, where appropriate, of the relevant passages †‡	Relevant to Claim No. §
Y	US, A, 3847724 (POWERS et al.) 12 November 1974 see figure 3; abstract; column 3, line 12 - column 4, line 34  --	1-10
Y	DE, A, 3705937 (SEITNER) 8 September 1988 see the whole document  --	1-10
A	EP, A, 0068873 (QUINTON & KAINES) 5 January 1983 see figures; page 4, line 14 - page 9, line 13; page 11, lines 1-5; claims (cited in the application)  --  . / .	1-6,8,10

- \* Special categories of cited documents: †
- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "g" document member of the same patent family

## IV. CERTIFICATION

Date of the Actual Completion of the International Search  
27th March 1991

Date of Mailing of this International Search Report

14 MAY 1991

International Searching Authority

Signature of Authorized Officer

EUROPEAN PATENT OFFICE

MISS D. S. KOVÁČZYK

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	US, A, 4720414 (BURGA) 19 January 1988 see abstract; column 4, lines 12-32  --	7
A	DE, A, 1804176 (IJI-TE AKTIEBOLAG) 8 May 1969 see figures 1,2; page 4, lines 2-19	1-3

**ANNEX TO THE INTERNATIONAL SEARCH REPORT**  
**ON INTERNATIONAL PATENT APPLICATION NO. GB 9001982**  
**SA 42939**

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 24/04/91. The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A- 3847724	12-11-74	SE-A-	7413419	21-08-75
DE-A- 3705937	08-09-88	None		
EP-A- 0068873	05-01-83	None		
US-A- 4720414	19-01-88	None		
DE-A- 1804176	08-05-69	BE-A- FR-A- GB-A- NL-A-	722805 1587168 1240516 6815290	01-04-69 13-03-70 28-07-71 29-04-69